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DISTRIBUTION AND BREEDING OF THE SLENDER-BILLED GULL *CHROICOCEPHALUS GENEI*, COMMON TERN *STERNA HIRUNDO* AND LITTLE TERN *STERNULA ALBIFRONS* IN ALGERIA

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RÉSUMÉ.— *Distribution et nidification du Goéland railleur* Chroicocephalus genei, *de la Sterne pierregarin* Sterna hirundo *et de la Sterne naine* Sternula albifrons *en Algérie*.— La connaissance de l'écologie de la reproduction des sternes, mouettes et goélands au Maghreb présente de sérieuses lacunes. Dans cet article, nous présentons des données sur la répartition et l'écologie de la reproduction de trois espèces, le Goéland railleur *Chroicocephalus genei*, la Sterne naine *Sternula albifrons* et la Sterne pierregarin *Sterna hirundo*, en Algérie. Pour le Goéland railleur, la plus ancienne colonie connue et de nouveaux sites de reproduction à travers le pays sont documentés. À l'inverse de cette répartition étendue, la Sterne naine et la Sterne pierregarin sont confinées chacune à un seul site de reproduction. Des réflexions sur la sélection des sites de reproduction, la compétition interspécifique et les paramètres de reproduction sont présentées alors que les facteurs affectant négativement la reproduction sont discutés.

SUMMARY.— The knowledge of the breeding ecology of terns and gulls in the Maghreb lags far behind that of other species. In this paper, we present data on the distribution and breeding of three species, Slender-billed Gull *Chroicocephalus genei*, Little Tern *Sternula albifrons* and Common Tern *Sterna hirundo*, in Algeria. New breeding sites across the country including the oldest breeding colony for the Slender-billed Gull in Algeria have been recorded whereas Little Tern and Common Tern have been found to be confined to single sites in northeastern Algeria. Insights on habitat selection, nest-site competition and breeding parameters are provided whereas factors adversely affecting reproduction are discussed.

Despite exhibiting a hyper-arid climate over most of the country, Algeria houses a large spectrum of wetlands (freshwater lakes and ponds, brackish marshes, lagoons and inland salt lakes, etc.) of great ecological interest (Samraoui & Samraoui, 2008). While the ornithological value of Algerian wetlands as winter quarters for migrant waterbirds was soon recognized (Ledant *et al*., 1981; Boulekhssaim *et al*., 2006; Meziane *et al*., 2014), it took much longer for their role as breeding sanctuaries to be fully appreciated (Samraoui *et al*., 2006, 2015; Boucheker *et al*., 2009; Nedjah *et al*., 2010; Fouzari *et al*., 2015).

A glaring example of this late recognition is that of Algerian salinas and salt lakes which were overlooked for their ornithological role for various reasons (transient nature, lack of access, remoteness, challenging climate, etc.). It was not until the 21th Century that the first systematic studies were undertaken. They were quickly rewarded by significant results (Samraoui *et al*., 2010, 2011).

While our knowledge of the wintering and breeding status of waterbirds in Algeria has, over the last decade, been markedly refined, there is still room for improvement when gulls and terns are concerned and progress on this front has been hampered by various causes, namely reduced populations, transient breeding sites and lack of access to salt lakes. This delay stands in sharp

contrast to a spate of recent studies on charadriiformes being carried out in neighbouring Tunisia (Chokri *et al*., 2010, 2011; Chokri & Selmi, 2012) and Morocco (Radi, 2004a, b; Hanane *et al*., 2005; Qninba *et al*., 2012).

With the exception of Yellow-legged Gull *Larus michahellis* which nests in numbers along the Algerian coast and which was the focus of recent studies (Baaloudj *et al*., 2012, 2014; Benhamiche-Hanifi & Moulaï, 2012; Talmat-Chaouchi *et al*., 2014), the distribution and various aspects of the reproduction of other nesting species like Audouin Gull *Larus audouinii*, Gull-billed Tern *Gelochelidon nilotica*, or Whiskered Tern *Chlidonias hybridus* are still poorly known and deserve more attention (Bakaria *et al*., 2002; Bouzid *et al.,* in prep.).

In this study, we present the results of a survey of all major wetlands across Algeria that spanned over 14 years (2002-2017), focusing on the distribution and breeding ecology of three species which have been barely investigated in the Maghreb so far: Slender-billed Gull *Chroicocephalus genei,* Common Tern *Sterna hirundo* and Little Tern *Sternula albifrons.*

METHODS

A survey of all major Algerian wetlands was conducted annually between 2002 and 2008 (Samraoui & Samraoui 2008; Samraoui *et al*., 2011). Unfortunately, not all sites could be monitored yearly. This effort was followed by regular visits to a smaller set of sites carried out between 2009 and 2017. On each occasion, the same sampling protocol was carried out with breeding development investigated through a telescope (Optolyth x20-60). Once hatching has occurred, nests were approached using a hide and chicks and remaining eggs counted. All statistical analyses were performed using R software (R Development Core Team, 2017).

RESULTS

Common Tern and Little Tern were each found confined to a single breeding site in northeast Algeria whereas Slender-billed Gull which, until the 21st Century was not believed to breed in Algeria, was found to be widely distributed across the country (Fig. 1). Common Tern was found to breed on a rocky island whereas Little Tern and Slender-billed Gull occupied a disused salina and salt lakes, respectively (Fig. 1). GPS coordinates of sites are listed in Samraoui & Samraoui (2008).

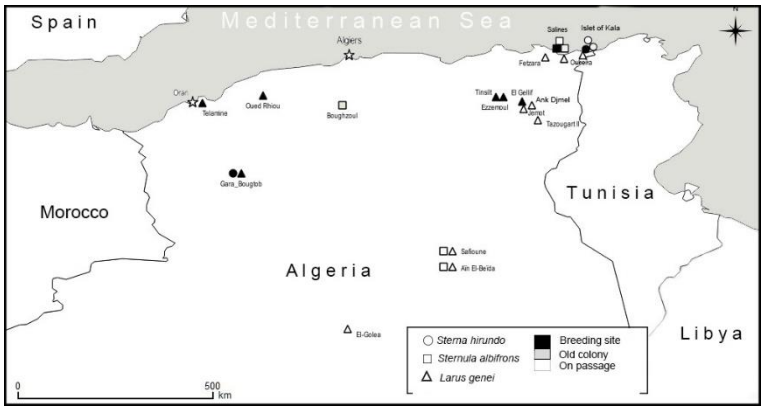

Figure 1.Distribution map of Common Tern, Little Tern and Slender-billed Tern across major wetland sites.

COMMON TERN

This study: Salines, Islet in front of Plage des Goélands (Fig. 2a).

Figure 2.— (a, upper) View of islet, a breeding site of Common Tern, offshore of the Plage des Goélands near El Kala. (b, lower) Nest with eggs of Common Tern.

Previous known colony: "Islet near El Kala" (Michelot & Laurent, 1992; 1993).

Breeding: Nesting of Common Tern occurred on a rocky substrate with rudimentary shallow nests made up of stems and leaves of *Lavatera* sp. The site also held a single nest of Kentish Plover *Charadrius alexandrinus* and old nests of a colony of Yellow-legged Gull *Larus michahellis* which deserted the island following the closure of a nearby open refuse dump.

The colony was discovered in 2004 and was only investigated during that year. The onset of egg-laying was in late May (Fig. 2b) with hatching first occurring on 23 June. Clutch size ranged from 1 to 3 (Fig. 3) and mean clutch size averaged 2.29 ± 0.76 eggs/nest (N= 7 clutches), a value intermediate between those recorded in Tunisia (range: 2.10-2.70 eggs/nest; Chokri *et al*., 2010) and France (2.53 eggs/nest; Yésou *et al*., 2005). One sample t-tests indicated that there were no significant differences between mean clutch sizes from the above countries ($t = 0.65$, $df = 6$, $p = 0.53$ and $t = -1.45$, $df = 6$, $p = 0.2$ for mean values of 2.1 and 2.7, respectively). In contrast, a significantly lower mean value (1.46 eggs/nest) was found in Mauritania (Campredon, 1987) (One sample t-test: $t = 2.89$, $df = 6$, $p = 0.028$).

LITTLE TERN

This study: Oued Boukhmira, Salines (Fig. 4a), Sidi Salem.

Previous known colony: Boughzoul (Jacob & Jacob, 1980; Jacob & Courbet, 1980), Mafragh (Michelot & Laurent, 1992; 1993), Sidi Salem (Metallaoui & Houhamdi, 2014).

Breeding: Nests of Little Tern were recorded in shallow scrapes in artificial temporary pond used decades ago to extract salt. The sparse vegetation was dominated by *Salicornia europea*. The colony was associated with nesting Kentish Plover and Collared Pratincole *Glareola pratincola*.

The onset of egg-laying was around 16 May with first hatching recorded on 15 June (Fig. 4b). Number of laid eggs per nest varied between 1 and 3 with 2 being the modal clutch size (Fig. 3). Mean clutch size averaged 2.0 ± 0.82 eggs/nest (N = 7 clutches), a value identical to that recorded

in Mauritania (Campredon, 1987) but is lower than that found in Morocco (2.2; Hanane *et al*., 2005), Tunisia (2.4-2.5; Chokri *et al*., 2010) and Spain (2.62; Oro *et al*., 2004). However, these values did not differ significantly from each other with the exception of a marginal significance exhibited by the Spanish population (One sample t-test: t = -2.0, df = 6, p = 0.09). This lack of significance may partly be explained by the limited sample.

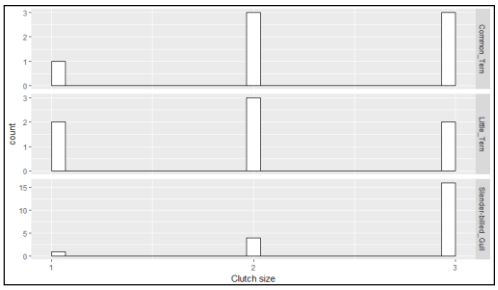

Figure 3.— Frequency distribution of clutch size of Common Tern at islet, Plage des Goélands, Little Tern at Salines and Slender-billed Tern at Guelif.

Figure 4.— (a, upper) View of Salines, a disused salina near Annaba. (b, lower) A Little Tern chick at Salines.

SLENDER-BILLED GULL

This study: (EN): Salines, Lac Oubeïra, Lac Mellah, O. Seybouse, Mafragh, Sidi Salem, (WN): Fetzara, (EHP): Guelif (Fig. 5a,b), Ezzemoul, Jemott, Tinsilt, TazougartII, Timerganine, Boulehilet, Ank Djmel, Lac Télamine, Garaet Bougtob (Fig. 6a), Oued Rhiou.

Figure 5.— (a, upper) View of Guelif, a salt lake in the Oum El Bouaghi wetland complex, Haut Plateaux. (b, lower) Colony of Slender-billed Gull attending nests at Guelif in 2005.

Previous known colony: None before our study but Cherief-Boutera *et al.* (2013) mentioned Dayet-El Kerfa as a breeding site in 2010.

In the semi-arid Hauts Plateaux, breeding in the temporary salt lakes is closely tied to the amount of rainfall cumulated during winter and early spring. The first successful breeding of the Greater Flamingo at Ezzemoul was recorded in 2005 (Samraoui *et al.* 2006). Both in 2006 and 2009, the same scenario was repeated: Slender-billed Gulls were first to occupy the islet at the beginning of April. Towards mid-April, while the gulls (50-70 pairs) were initiating incubation, Greater Flamingos *Phoenicopterus roseus* started parading and soon invaded the islet thus displacing the gull colony (Boulkhssaïm *et al*., 2009). Following the colonization of the islet, thousands of flamingo pairs went on to breed successfully after the gulls deserted the site (Samraoui *et al*., 2006; 2010).

In 2005, at Guelif, Slender-billed Gulls nested in association with Gull-billed Terns (Bouzid *et al*., in prep.), Avocets *Recurvirostra avosetta*, Black-winged Stilts *Himantopus himantopus*, Kentish Plovers and Shelducks *Tadorna tadorna*. A colony of 120 breeding pairs started egg-laying in late April. Nest structures varied considerably ranging from a shallow scrape on the bare ground to rudimentary nests made up of dried vegetation and feathers.

Figure 6.— (a, upper) View of the salt lake of Bougtob. (b, lower) Nest of Slender-billed Gull at Bougtob with newly hatched chick and egg.

The first hatching occurred in the last decade of May. Clutch size varied from 1 to 3 (Fig. 3) with mean clutch size averaging 2.71 ± 0.56 (N = 21 clutches). The recorded mean clutch size at Guelif is similar to the one (2.8 eggs/nest) found at Dayet El Kerfa (Cherief-Boutera *et al*., 2013) and is marginally higher to the one recorded in Tunisia (2.5 eggs/nest; Chokri & Selmi, 2012) (One Sample t-test: t = 1.75, df = 20, p = 0.10). However, the mean clutches recorded in Algeria are significantly higher to the one recorded in Mauritania (2.29 eggs/nest; Campredon, 1987) (One Sample t-test: t = 3.5, df = 20, p = 0.002).

In 2012, at Garaet Bougtob, nesting of Slender-billed Gulls occurred in association with Black-winged Stilts, Avocets, Kentish Plovers and Gull-billed Terns. The outcome was also successful (Fig. 6b) and larger clutches (4 eggs) were recorded. In addition, based on the differential textures and colours of their eggs, some of these larger clutches may have been laid by two females.

DISCUSSION

DISTRIBUTION

Common Tern bred in the 19th Century on the Algerian coast and at nearby coastal lakes (Heim de Balsac & Mayaud, 1962). Specifically, a single colony near El Kala was known in the 20th Century (Michelot & Laurent, 1992; 1993). Nowadays, Common Terns do not breed anymore in the freshwater lakes of the region and the islet offshore of the Plage des Goélands is their last stronghold in Algeria. The colony was previously protected by the difficult access to the beach but a new road and the concomitant massive inrush of holydaymakers will inevitably spell doom for the beleaguered colony. Common Terns are often victims of kleptoparasitism by gulls (Seco Pon

& Morettini, 2009), so their previous coexistence with Yellow-legged Gulls, known opportunistic predators of eggs and chicks, raises questions (Hernández-Matías & Ruiz, 2003; Canova & Fasola, 2004).

In the Maghreb, Little Terns breed from Libya to Mauritania (Isenmann *et al*., 2010, 2016). In Algeria, small colonies of Little Terns were previously recorded at Boughzoul (Jacob & Jacob, 1980; Jacob & Courbet, 1980) and at the Mafragh near Annaba (Michelot & Laurent, 1993). A new colony was found in 2008 on the beach of Sidi Salem (Metallaoui & Houhamdi, 2014), adjacent to the Salines were a small colony has been known since 2002 (Samraoui & Samraoui, 2008). Nesting of Little Terns is most often associated with that of Kentish Plovers but Collared Pratincoles and Black-winged Stilts *Himantopus himantopus* have also been recorded elsewhere (Calado, 1996; Hanane *et al.*, 2005).

Breeding of the Slender-billed Gull in the Maghreb was known from Mauritania (Isenmann *et al*., 2010) and occasionally from Tunisia and Morocco (Isenmann & Goutner, 1993). In Algeria, it was first documented at the beginning of the 21st Century (Samraoui & Samraoui 2008; Boulkhssaim *et al*., 2009; Samraoui *et al*., 2011). In addition, a new Algerian colony was later found at Dayet El-Kerfa, near Boughzoul in 2010 (Cherief-Boutera *et al*., 2013).

HABITAT AND NEST SITE SELECTION

In the context of their threatened status in Algeria and elsewhere, habitat selection of Little and Common Terns as well as their response to environmental change are still inadequately understood. Locally, Little Terns are mainly found breeding on beaches and coastal salinas but are known to occupy a wider spectrum of habitats like salt marshes, dams and riverine habitats (Cramp, 1985; Huang, 2015). Vegetation cover may play a key role in habitat selection and may vary according to habitats for both Little Tern (Goutner, 1990; Ratcliffe *et al.*, 2008; Lopes *et al*., 2015) and Common Tern (Blokpoel *et al.*, 1978; Yésou *et al.*, 2005) and this preference may explain the "fugitive strategy" adopted by the former species in its nomadic search for optimal breeding conditions (Lopes *et al*., 2015). On the Po River, Italy, the extent of bare sands was shown to determine the breeding frequency of both Little Tern and Common Tern (Fasola & Bogliani, 1984).

Similarly, processes driving the dynamics of the metapopulation of Slender-billed Gulls are still poorly understood (Oro, 2002; Sanz-Aguilar *et al*., 2014). In particular, we know little about environmental cues influencing colony site selection (Chokri *et al*., 2011) which is probably linked to a preference for transient, unstable habitats. At least in the Mediterranean region, there is a marked preference for sparse vegetation cover around the colony (Isenmann, 1976, Dies & Dies, 2000). In Algeria, the species breeds in natural habitats like islets within continental lagoons whereas it breeds on both isolated islets and accessible dykes of artificial basins in the Sfax Salina (Chokri & Selmi, 2012).

BREEDING ECOLOGY

Common Tern

The first clutches of Common Tern were recorded in late May and the timing was comparable to those recorded on the western French coast (Yésou *et al*., 2005) and in New York, USA (Bollinger *et al*., 1990). In contrast, the first clutches in Tunisia were recorded earlier (third week of April) and hatching is thus advanced by a month (May instead of June) (Chokri *et al*., 2010).

Little Tern

The onset of egg-laying (mid-May) of the Little Tern in Algeria seems to occur later than in Mauritania (Early March: Campredon, 1987) or Tunisia (third week of April: Chokri *et al*., 2010). The warmer climates of Sfax and the Banc d'Arguin may explain the earlier shift in egg-laying in

those sites compared to other Maghrebian or European sites (Calado, 1996; Hanane *et al*., 2005; this study).

In addition to a smaller mean clutch size, Little Tern in the Salines exhibited a low reproductive output with most clutches predated by feral dogs, trampled or inundated. A similar poor breeding performance was also recorded in Tunisia (Chokri *et al*., 2010) and Portugal (Calado, 1996).

Slender-billed Gull

The onset of egg-laying by Slender-billed Gull in the Maghreb is markedly earlier than that recorded in the Camargue where egg-laying occurs between mid-May and early June (Isenmann, 1976). Indeed, the timing of the first clutches (last 10-day of April) at Guelif is identical to that recorded at Dayet El Kerfa (Cherief-Boutera *et al*., 2013). Similarly, the onset of egg-laying in Tunisia was also found to be similar to that noted in Algeria (Chokri & Selmi, 2012) with hatching mainly occurring during the second half of May.

As mentioned by Erard (1958), Slender-billed Gulls usually breed in the company of Gull-billed Terns and waders which dwell on temporary wetlands (Bouzid *et al*., in prep.). Colonies of Slender-billed Gulls are characterized by a high degree of synchronization and creching behavior, two adaptations linked to instable habitats (Besnard *et al*., 2002). Similarly, the concomitant nesting of aggressive species like the Avocet appears to compensate for the vulnerability of Slender-billed Gulls and terns by quickly raising the alarm and harrying potential predators (Isenmann, 1976; Burger & Gochfeld, 2016). This association may considerably increase breeding success of the mixed colony.

Our records of Greater Flamingos driving out forcefully incubating Slender-billed Gulls appears to be a recurrent pattern of competition over nest-sites which may often represent a limited resource (Newton, 1998) much like tree cavities for hole-nesters (Charter *et al*., 2016). Indeed, relatively safe islets in ephemeral salt lakes across the Maghreb may be a severe limiting factor for thousands of Greater Flamingos in their quest for a safe nest-site (Samraoui *et al*., 2006; Boulkhssaïm *et al*., 2009). While dominance mediated through body size has been established for nesting colonial herons (Burger, 1982; Fasola & Alieri, 1992), spatial displacement by Greater Flamingos of Slender-billed Gulls, culminating into a total exclusion from the breeding site, has never been reported previously.

Our finding of seemingly distinct egg colours and textures within large clutches (4 eggs) is congruent with a previous report of larger clutches (5 eggs) from Tunisian colonies suggesting cases of nest parasitism (Chokri & Selmi, 2012). Conspecific brood parasitism consists of one female laying her eggs in the nests of other conspecific females thereby taking advantage of their parental care (Yom-Tov, 1980, 2001). Slender-billed Gull's life history traits match all the characteristics of this widespread alternative reproductive strategy that is prevalent in colonial species that have precocial young (Rohwer & Freeman, 1989). An alternative explanation for the occurrence of mixed clutches may be the existence of agonistic interactions among nesting birds, especially in case of disturbances (Somers *et al*., 2011). However, this is an unlikely explanation as agonistic interactions are rare among Slender-billed Gulls (Isenmann, 1976) which seem to display strong group tenacity (Francesiaz *et al*., 2017).

CONSERVATION

The study species and in particular the Common Tern and the Little Tern are extremely vulnerable to tourism and coastal development (Fasola & Canova, 1992; Barcena *et al*., 1984) and their known breeding habitats are in urgent need of site management. The low levels of productivity displayed by Little Tern and the precarity of the single colony of Common Tern raise concerns as to their perennity in Algeria and possibly the Maghreb as the known populations are probably insufficient to maintain a viable population without immigration. Thus, there is a real

urgency to adopt a metapopulation approach (Sanz-Aguilar *et al*., 2014) and enact a management plan (Nisbet & Spendelow, 1999; Palestis, 2014) which addresses multiple stressors such as hydraulic changes, egg pilfering and hunting, human disturbance, islet erosion, predation, etc. that threaten the known habitats of breeding gulls and terns (Nisbet, 2000; Chokri *et al*., 2011). In addition, the vast Algerian salt lakes are also increasingly threatened by numerous development projects (dams and hillside catchment reservoirs, new roads and housing estates) which imperil the function and sustainability of these ecosystems (Béchet & Samraoui, 2010; Demnati *et al*., 2017). Fortunately, solutions do exist as alongside coastal management, man-made habitats may also provide useful alternative breeding sites that may compensate for the rapid loss of natural habitats (Burgess & Hirons, 1992; Catry *et al*., 2004; Pakanen *et al*., 2014).

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